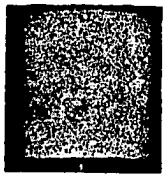
THE DIRECTOR OF
CENTRAL INTELLIGENCE



National Intelligence Council

19 February 1985

Dr. George A. Keyworth
Office of Science & Technology Policy

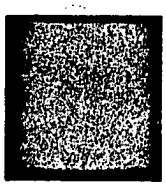
Jay,

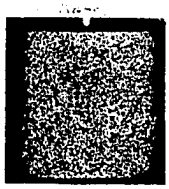
This piece from a recent issue of the Economist offers an exceptionally good insight to Europe's problem. You get an equally fascinating, but more philosophical insight, from The World After Oil, by a buddy of mine at Business Week named Bruce Nussbaum. You might just turn to Chapter 3, which deals with Germany. It's probably the best chapter in the book.

HEM

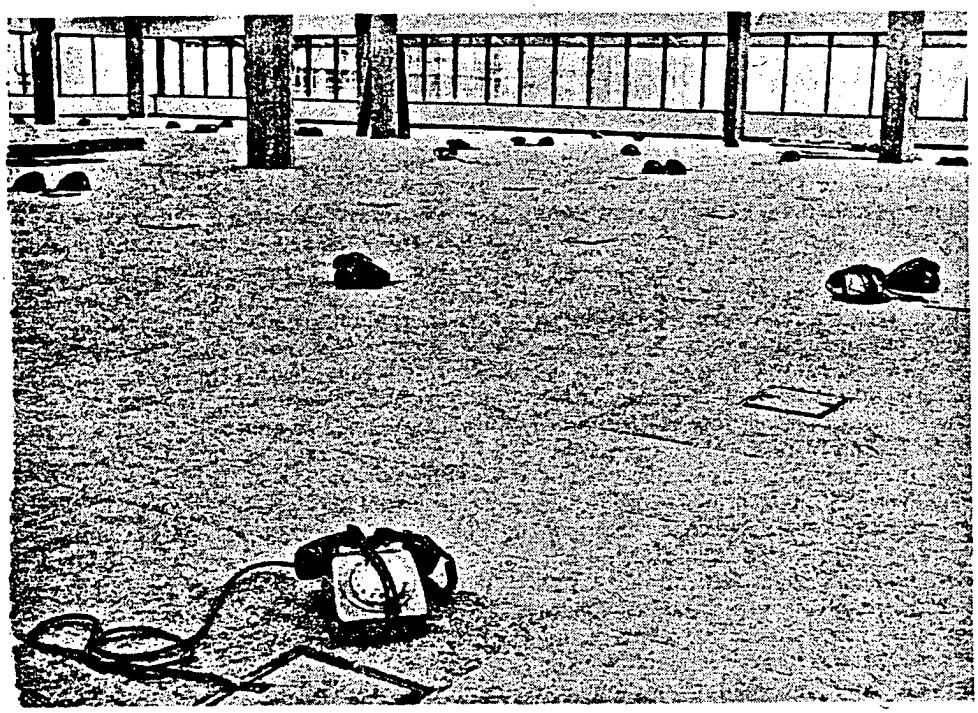
Herbert E. Meyer

Attachments:
Economist article
The World After Oil





EUROPE'S TECHNOLOGY GAP



The old world's new fears

Europe often looks for safety first—wars, recession and old age have made it that way. But this natural caution may prove suicidal now that the world is in the midst of a deep technological and economic change. America and Japan have been racing to meet this challenge—and seem to be prospering. Europe has held back, and now seems to be faltering. Is a technology gap opening up between Europe on the one hand and Japan and America on the other? What should Europeans do about it?

Western Europe's economies have been growing feebly. Their ability to provide jobs has been weaker still: in the decade after the 1973 oil shock, the United States created 14m jobs and Japan 3m; the countries of the European community lost almost 2m. Most predictions are that the last half of the 1980s will continue the tale of European stagnation.

The problem has outgrown its economic dimension and now has political consequences. Mr Lawrence Eagleburger, who was America's undersecretary of state for political affairs until he retired last spring, fears that an economically uncompetitive western Europe would be an increasingly unconfident, protectionist, and eastward-looking Europe. He stirred controversy by musing out loud about this last winter. He now says, with admitted exaggeration, that western Europe could find itself in 40 years in the top tier of third-world countries.

The words would be less shocking if they did not come from a friend of Europe. Europeans should take some time to listen to the rude thoughts of those indifferent to it. The Californians in Silicon Valley, who have done so much to remake America in the past 15 years, simply wave talk of Europe aside: Europe does not matter, except as a good market; their competitive antennae are tuned across the Pacific, to Japan. It is a compliment the Japanese return.

Europessimism is a fashion that comes and goes. The difference this time is that many of the fears about Europe have been collecting around a single broad notion: the apparent inability of Europeans to compete with the Americans and Japanese in high-technology industries. Europe has been losing (along with the rest of the advanced world) the old heavy industries like steel that used to underlie its prosperity. But it seems unable to follow America and Japan into the new science-and-technology-based industries that will generate the wealth of advanced nations for the next 50 years.

The idea of a technology gap, with an uncompetitive Europe on the wrong side of it, deserves a very cold eye. First, high technology is a dubious concept: nobody knows how to define it. America's bureau of labour statistics tried its hand at a few definitions. One of them turned up such well-known high-tech industries as "soaps, cleaners, and toilet preparations" and "hydraulic cement".

Even on a definition of high tech that feels right—such as the bureau's one that produced drugs, computers, telecommunications, electronic components, aircraft, and missiles and spacecraft as high-tech industries—there are wide variations in performance. Europe's nuclear power industry is better off than America's, Airbus competes (sometimes) successfully with Boeing for American aircraft orders, and the Ariane rocket has been beating Nasa's space shuttle as a commercial satellite launcher. Western Europe's share of the worldwide pharmaceuticals market is some 30%; its share of telecommunications equipment in 1982 was 27%. Both exceed Europe's share of gross world product.

Nor is it fair to speak of western Europe as a single place. Performance in high-tech industries varies a lot from one country to another. France, for instance, is strong in nuclear power, rocket launchers and miltary technology; Britain excels in software writing, which France has lately been lagging in.

Despite these reservations, few doubt that Europe is in real trouble. There are two reasons, one specific, the other much broader. The specific worry is Europe's poor performance in the information industries—the constellation of electronics-based industries which produce the hardware and software used to process

information. The general worry is Europe's inability to innovate: its sluggishness in creating the new businesses, high-tech and low, which alone can generate growth and jobs.

The uninformed. . .

Europe has a bad record, which is getting worse, in electronics. The unpretty picture painted by the chart below shows a worsening European trade balance for the past two years in every line of electronics. This has happened despite a sky-high dollar that should have been sending Europe's balance of electronics trade in the other direction.

This poor showing is important because the manufacture of information technology is already one of the world's biggest industries. IBM's director of market research, Mr Peter Schavoir, reckons that the industry's annual American revenues now exceed $110 billion; that accounts for 3.3% of the American gnp and is about equal in size to the car industry. Mr Schavoir predicts that in 1994 the information industry's annual production will be worth some $330 billion, 6% of American gnp. Mr Ian Mackintosh of the British market consultancy Mackintosh International reckons that the comparable worldwide figures are nearly $300 billion in 1984—and more than a trillion dollars in the mid-1990s. Before 1990, information technology will be the world's biggest manufacturing industry.

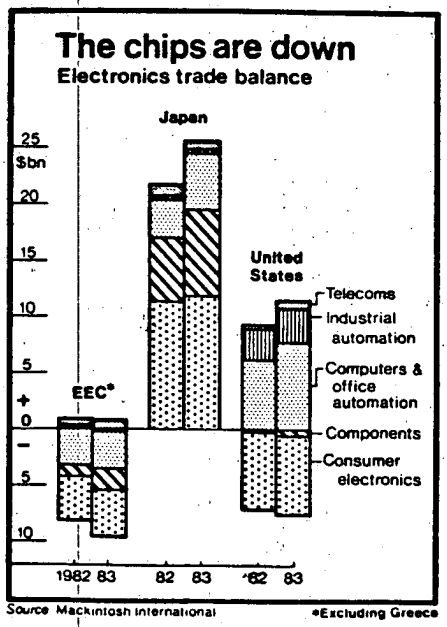
The EEC countries' balance of electronics trade was already more than $9 billion in deficit last year. On present trends that will lead to a shortfall of some $26 billion a year by 1994. In itself this is not a crisis. Electronics will make up a big chunk of manufacturing industry, but like all manufacturing businesses will continue to employ fewer and fewer people to produce each unit of output. Mr Schavoir expects that, even with compound annual growth rates of 15% for the next 10 years, the information technology industry will generate only 1m new jobs in the United States by 1994.

Far more disturbing news for Europe comes on the other side of the equation: the application of electronics. Most of that information technology is being bought either for incorporation into other products or for use by people who are employed to process information. Viscount Etienne Davignon, who retires as EEC industry commissioner at the end of this year, guesses that the use of electronics has important effects on some 80% of industrial production in an advanced country. The best example comes from the American defence budget: in 1970 about 27% of the money spent by the Pentagon on procurement went for electronics; 34% was spent on electronics in 1980, and by one estimate the figure will exceed 40% by 1990.

The other way in which the economy absorbs electronics is by increasing the number of workers who use information technology. Everybody is familiar with the shift that has been going on in advanced economies from manufacturing to services. A similar shift has recently been occurring between production workers (those who stand on assembly lines, pilot aeroplanes or serve food) and information workers (those like secretaries, bank presidents and software writers, whose job is to create or distribute information). Fewer than 45% of American workers in 1960 were information workers; by last year more than 56% were.

Why can Europe not simply buy its information technology from America or Japan, incorporate it into its own products and processes and prosper as they do? It already does this to some extent. The West German firm Robert Bosch, which makes electronic controls for cars such as fuel-injection devices and anti-skid braking systems, depends heavily on integrated circuits for its products, but it buys only a third of its chips within Europe. It has its own integrated-circuit design centre and contracts with American firms such as Texas Instruments to turn the designs into silicon. Mr Hans Merkle, the chairman of the company's supervisory board, says Bosch has never had a problem getting the chips it needed at the right time and the right price.

But the incorporation of electronics is not happening nearly fast enough in Europe. European consumption of semiconductor chips, which are the foundation for all other electronics production, has fallen in the past 10 years from 30% to 19% of the world's total; per-capita consumption is only one third of America's and one quarter of Japan's. Production has fallen apace: Europe supplied 14.5% of the world's semiconductors 10 years ago, and now supplies only 9.5%. If the relation between production and consumption holds, the future looks even more chilling: Europe's market share for the supply of advanced metal-oxide-semiconductors, which will dominate chip-making for the next few years, is only 6%.



Europe's already limited ability to absorb electronics by buying it from abroad is further threatened by the shortening life of electronics products. A sophisticated one takes 8-10 years to be brought from conception to market. The immense investment this requires must then be recouped within two years. Take the public telephone switch: the old electromechanical kind had a sales life of at least 10 years; the new electronic switches, which cost $500m-1 billion to develop, are obsolete within five years of the first sale.

This does not make those who develop a new technology eager to license it to anybody else. Moreover, the increasing complexity of the technology, combined with its brief life, makes it harder for those who eventually do get licences to master it in time to make a product somebody wants to buy.

There is another, technological, problem. More and more of the design of an entire electronics system is being squeezed on to a single piece of silicon. Mr Pasquale Pistorio, the head of the Italian chip-making firm SGS-Ates, says that this demands close co-operation between those who incorporate chips into their products and the people who are making the chips. It is naive to think that IBM and several other American computer-makers are not carefully consulted by Intel (for example) when it is making tomorrow's microprocessor chip. What this means for European computer companies is that they understand the basic workings of their next-generation machines far later than their competitors (as much as 18 months by one reckoning). Set this delay against the background of a continually shortening product cycle.

. . . and the unadventurous

Europe's weakness in information technology is a symptom of a more deep-rooted failing. One comparison provides a clue to it. Of the top 10 American semiconductor firms in 1957, only one or

two were still on the list in 1982; in Europe eight of the same firms were. Europe has been dangerously stable.

Why dangerously? It has become obvious first in electronics, but is true of most industries, that the world is in one of its great economic transitions. The last one of this size happened a century ago, with the birth of the chemical, electrical and car industries. These creative bursts have characteristic features. One is the unpredictability of demand (and uselessness of any central planning). For instance, 10 years ago there were no personal computers; today they account for a market worth $14 billion, served by some 160 manufacturers. A second characteristic is the creation of large numbers of new companies, which explode thousands of new ideas over the commercial landscape; most die off fast, while many of the survivors grow quickly into big firms. A third quality is that nobody is safe: well-established companies that try to remain stable are even more likely to go bust than the experimenters.

America is thriving in this creative chaos: 600,000 companies were formed in the past year, 40,000 failed. Mr David Birch of the Massachusetts Institute of Technology has made a study of innovation in the United States. He found 16 exceptionally innovative businesses (measured by how fast companies in each sector grew). The high-tech industries are there—but so are the unfashionable trades of coal mining and department stores.*

High-tech innovation creates opportunities for new industries that are not themselves high tech. Mr Bruce Merrifield, an assistant secretary in the United States commerce department (and one of the winners this year of the Nobel prize for chemistry), believes that every new high-tech job creates between six and eight low-tech ones. But it is more important for growth that the habit of innovation is strong in the far-bigger low-tech sectors. It is small, young companies which create jobs: half of America's net employment growth in 1977-81 came from firms with 20 or fewer employees, and 80% from firms with fewer than 500. More than 60% of the new jobs in that period were created by firms younger than five years. What studies there are for Japan and Europe show that their small, new firms play a similar role.

Innovation is a hard quality to measure, but it seems clear that Europe has less of it than America or Japan do. Mr Henry Ergas, of the Organisation for Economic Co-operation and Development (OECD), has made rough estimates of birth and death rates for manufacturing firms (firms respectively created and terminated as a percentage of total firms):

	Births %	Deaths %
Japan	4.0	3.6
US	3.7	3.6
West Germany	3.4	1.2
France	1.9	1.2

The thing that distinguishes the two European countries is their slow turnover.

Europe's problem is that it is attached to stability in an age when stability is a comparative disadvantage. This applies to people as well as ideas: nearly 30% of Americans in 1981 changed jobs at least once in the previous year, compared with 10% who did likewise in the European community in 1977. Olivetti's chairman, Mr Carlo de Benedetti, says that his fellow industrialists worry about the wrong thing when they complain about the *scala mobile*: his own business is not constrained at all by the cost of labour, but it is severely hampered by the immobility and inflexibility of labour—managers and workers alike.

Innovation was more popular once

No novelty, please

The constraints on innovation in western Europe come in many forms. These are the most important ones.

● **Markets.** Young, innovative European firms labour under crippling burdens that their American and Japanese counterparts do not have. One—the uncommon market—is well known, though the extent of the damage it does is not. Testing and certification requirements, differing standards, border delays and restraints on trade in services all take their toll on trade between EEC countries. These obstacles add as much as 20% to the cost of goods in intracommunity trade. They impede companies just starting out more than others. A fledgling in America or Japan can test its strength in a market big enough to bring it to medium size before it takes on foreign sales; a European start-up cannot. And the effects of Europe's market fragmentation are getting worse all the time: as development costs rise and product lives contract, it becomes even harder to recoup investment in a single national market.

One solution, which requires a lot of discipline, is for a company to begin with the idea of selling to the wider world. Scandinavian and Dutch firms with their tiny domestic markets are practised in this. Mr Geoffrey Taylor, who heads the venture capital unit of the British investment firm 3i, says that he forces the new companies he finances to think from the start about selling into America.

Another burden on marketing in Europe is the lack of sophistication of the buyers. In the cruel words of Salford University's vice-chancellor, Mr John Ashworth, "You can sell any sort of rubbish in Britain". This sounds like a gift to sellers; it is not. A sophisticated public forces sellers to innovate—and toughens them to world-wise competitors from abroad. Mr Ashworth, who has become Britain's innovation gadfly, says that the government should be spending its R&D money not on fancy research projects, but instead on teaching businessmen to be more demanding.

● **Government spending.** Government procurement accounts for an immense market—equal to some 17% of European community gdp. European governments have wielded their purchasing power for ill in two ways. The first is by discriminating in favour of domestic producers. This has been most flagrant in telecommunications, but it happens with all high-tech products. In October the EEC commission issued a declaration which feebly "urged" member states to open 10% of their telecommunications purchasing to products from other EEC countries.

The other discrimination in European public procurement is in favour of big companies. Government contracts can be a lifeline for small firms and new industries. The United States uses various devices to encourage government purchases of products from small firms. A recent study found that almost half the

*Mr Birch's complete list: coal mining, dried and frozen fruits and vegetables, oil refining, steel, computers, household appliances, communications equipment, colleges and universities, electronic components, motorcycles and bicycles, railroads, airlines, department stores, medical and health care, insurance, holding companies.

first-year sales of small firms in its sample were made to the federal government.

Not so in Europe. Past European orthodoxy was that each country could compete best with the Americans by backing a big "national champion" to take them on. The bureaucrats continue to put their (taxpayers') money where their mouths are. Six firms in France receive more than half the money the French government transfers to industry; some 80% of the British government's support for microelectronics has gone to five firms, and Ferranti alone raked in half the total.

Government support for R&D is a vital stimulus to innovation. The table shows recent data for R&D spending in OECD countries. America's federal government is due to spend some $53 billion on R&D in the fiscal year that began in October; about $34 billion is to be spent by the defence department. It is hard to overstate the benefits the American electronics industry received from defence and space spending on R&D in the two decades following the mid-1950s. (It is less important now, in chips at least, because military and civilian electronics have diverged so much.) Much of the benefit has come from the skilful deployment of rather small sums by the Defence Advanced Research Projects Agency.

So Europe's recent fit of government projects to support electronics R&D is not misconceived. In the past two years, three major European projects have got under way. The EEC's Esprit programme is due to cost 1.5 billion ecus (half supplied by the community, half by industry) over five years. Britain's Alvey programme is spending £150m over five years to support advanced artificial-intelligence research. West Germany has a five-year programme to spend DM3 billion ($1 billion) on electronics research.

The trouble is that these programmes are repeating the same old European mistakes. The big boys are nosing into the trough first, as usual. Big firms are heading almost every Alvey project. The West German minister for research and technology, Mr Heinz Riesenhuber, is a passionate admirer of the revolution Silicon Valley has wrought; but DM300m of his budget has just been given to Siemens, Germany's cash-rich and biggest electronics firm, for a joint development programme with the giant Dutch firm, Philips—and this for a single product.

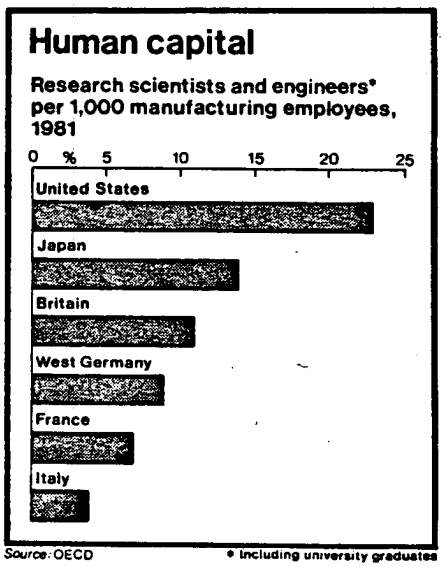
R&D spending

	Government % Defence	Other	Private%	$ billion Total
US (1984)	32	16	52	100
Japan (1981-82)	1	26	73	26
W. Germany (1983)	4	37	59	17
UK (1981-82)	24	25	51	12
France (1982)	21	38	41	11
Italy (1982)	2	47	51	4

Sources: OECD, Economist estimates

● **Capital.** America's venture capitalists give both early cash and management help to firms starting out. This system has provided an extremely efficient mechanism for launching small firms. In 1983 $2.8 billion in venture capital was committed to start-ups in America. Once a firm has outgrown the venture capital phase, moreover, there is a smooth upward path to other kinds of equity capital.

The situation is different in Europe. Europeans have mistakenly tended to use government subsidies instead of market-based risk capital to finance young firms. By one estimate, venture capital investment in western Europe runs at only 10-20% of the American level.



There are large variations within Europe. Britain has the best-developed venture capital and follow-on public markets. Ms Sue Lloyd, who heads UK Venture Capital Journal, reckons that £83m in venture capital was committed in Britain in 1983. Outside Britain there is still little risk capital available to entrepreneurs. There are signs, however, that things are improving. West Germany's Siemens, for instance, has set up a venture capital unit to help employees establish entrepreneurial businesses of their own.

Those who want to take the step from start-up to mid-size firm also face frustrations. Mr Mads Ovlisen, head of the Danish drug company Novo Industri, says his firm was held back in the 1970s by the lack of a good European capital market. He finally managed to raise some convertible debt in London in the early 1980s—a process that then took 18 months and could, he says, have been done in three months in the United States. West Germany's record in follow-on financing for new firms is dismal: only 21 new companies got stock-exchange listings in Germany between the end of the war and 1977, when the law was changed to make it easier; since then another 40 or 50 have joined them.

● **Universities and training.** In the late nineteenth century West Germany's young chemical industry took off partly because of its close and successful collaboration with the universities. Those were the days. West German professors today are tenured civil servants who receive 14 monthly salaries a year and think of businessmen as philistines when they do not think of them as class enemies. Dr Karl Gareis, who is in charge of the biotechnology programme at the chemical giant Hoechst, thought Hoechst needed a close tie to an academic laboratory. After failing to find a European partner, he scandalised the German establishment by making a $50m transatlantic deal with Massachusetts General Hospital.

The highest-tech American industrial centres all benefit from important nearby universities such as Stanford, Berkeley, MIT and the University of Texas. But the links between universities and business range throughout America's extensive higher educational system. Mr Ergas at the OECD estimates that some 7% of American university research is paid for by industry: much more than in Europe.

The atmosphere may be improving: the high-tech firms springing up around Cambridge University are the best example. But the anecdotes can still be discouraging. Mr Axel Ullrich, a West German who is one of the principal scientists with the Californian biotechnology firm Genentech, is thinking of returning to university life and has been negotiating with both German and American universities. The Americans have been enthusiastically outbidding one another. Not the Germans. The University of Heidelberg offered him a five-year contract, with a salary 30% less than he is getting now and less lab space: not for want of resources, but because he could not be given any more than other professors at his level in the lock-step promotional system.

Europe has lagged, too, in its production of engineers and scientists. The chart shows that America and Japan are ahead of western Europe in the number of research scientists and engineers per manufacturing employee. Europe's problem is aggravated by a continuing brain drain. This is most destructive in the early stages of an industry, and the signs for European biotechnology are already alarming. Britain's Science and Engineering Research Council thinks that as many as 10% of British biotechnologists are working overseas.

● **Laws.** Three kinds of western European laws hamper the development of inno-

vative firms. The first is tax. European income taxes are too high; the EEC commission has just called on European governments to start lowering them by 1% a year. Other taxes bear more heavily on start-ups. There was a spurt in American venture-capital investment after capital gains taxes were lowered in 1978. One of the most stimulative American devices has been something called an R&D limited partnership: people with income to shelter from tax invest it in a partnership which gets tax breaks through putting money into high-risk industrial R&D.

Other laws restrict the incentives that entrepreneurs can be offered for going into a start-up. The backbone of the American system is the share option. Anybody starting a firm or joining it in a high position shortly after start-up receives shares for a low price and share options that entitle him to buy large blocks of shares very cheaply. If the company takes off, the option holders can cash in—and become millionaires. In most European countries this is impossible. A provision in Britain's 1984 budget

America calling

Telecommunications will be Europe's next big test. The market is large and is about to expand substantially. Dataquest, the Californian market research firm, estimates that the combined American and European markets for customer equipment will nearly double between 1983 and 1988, to some $16.5 billion; for data communications, will more than triple, to $5.6 billion; for cellular radio, will jump from less than $200m to more than $2 billion.

The telecommunications industry is important for two reasons: it is an advanced electronics industry whose growth has the potential to resurrect basic European electronics sectors such as semiconductors; and it is at the centre of the next stage of computer and office-systems development. European telecommunications companies have held their own so far against American and Japanese competition. Will they continue to do so?

The main challenge to Europe's traditional telecommunications habits comes from America's swift and radical deregulation of its own telephone system. The settlement of the federal government's antitrust case against American Telephone & Telegraph (AT&T), which the federal judge Mr Harold Greene approved in 1982, has resulted in AT&T being stripped of seven regional operating companies, each of them slightly larger than the telephone monopolies in the biggest European countries. AT&T itself is left with long-distance and international services, telephone equipment and data networks; it is free go into any other business anywhere.

Each of the regional companies has a partial-monopoly over local services in its own area, but is free (subject to Judge Greene's approval) to go into related businesses, such as selling computers. The result is that telecommunications in the United States has become entirely market-driven. This change, says Judge Greene, was inevitable because technology has destroyed the idea of the "natural" telecommunications monopoly.

But it was not inevitable that America would remove the obstacles to a market-driven system as swiftly or completely as it did. The result has been an extraordinary flourishing of competition, not only among the heirs of Ma Bell, who are fighting hard for permission to enter all kinds of markets, but among hundreds of new entrepreneurs who make equipment, connect telephones to computers and lease and re-lease lines to provide communications services of their own.

Echoes of this tumult can be heard in Europe. Britain is part-privatising British Telecom and is allowing some limited competition for the rest of this decade. Even these timid steps have changed the British atmosphere. The rest of the EEC has not done even that much.

Western Europe suffers from restraints on innovation even more in telecommunications than it does in other lines of electronics. The most serious is a severe division by national markets. It has been nearly impossible for public-switch makers in one EEC member state to sell their equipment in another (though outsiders, such as Sweden's L.M. Ericsson or America's ITT, have managed to do it through local subsidiaries and joint ventures). One reason the markets have been closed off is that each country has specified a slightly different standard for equipment. Another is the close and unhealthy relationships that developed between each country's telecoms monopoly and one or two dominant national equipment suppliers (Siemens in West Germany, CIT-Alcatel and Thomson in France, GEC, Plessey and STC in Britain).

The growth of private telephone equipment makers has been stifled for similar reasons. Mr James Carreker, who analyses telecommunications for Dataquest, reckons that having to redesign a private office switching system (PBX) adds 12-15% to the product's R&D cost and 8-12 months of extra development time for each European country the PBX is introduced into. In the United States anybody who wants to sell a PBX can have the product certified within about two months at any registered testing agency. It took the West German computer firm Nixdorf some two years to get Bundespost approval for the PBX it wanted to sell in competition with one from Siemens.

Lastly, there has been almost no opening in Europe for the kind of competition in business communications services that is commonplace in America. Even in sort-of-deregulating Britain, it is still illegal for a company to lease lines from British Telecom and resell them to third parties.

Europe's fragmented markets have been the cause of an appalling waste of resources. Japan, North America and western Europe are similar-sized markets. Japan's total R&D expenditures on the latest generation of public digital switches (by two companies) was $1.5 billion-2 billion; North America's (by three companies) some $3 billion; western Europe's was more than $10 billion, spent on 10 different switching systems.

The profligacy with human resources has been worse. Mr Malcolm Ross, with the management consultant firm Arthur D. Little in Wiesbaden, estimates that western Europe used three times as many hardware and software engineers as either North America or Japan in developing its switches. He says that 25% of all European systems software engineers—the most sought-after people in the computer business—were kept busy designing public switches, compared with 10% in Japan.

Europe has got away with this so far because, until digital switches came in, it was possible to recoup R&D costs for a switch in a single national market the size of (say) Britain's. Big sales to the Middle East postponed the day of reckoning for the first generation of digital switches. Europe now faces problems: not all of its three-times-too-many public-switch makers can stay in business.

A more basic challenge comes from the merging of computers, office systems and telecommunications and by the decision of America (and, more mildly, Japan) to let a free market determine how it will develop. Mr Bjorn Svedberg, the president of Ericsson, has no doubt about the response that western Europe must make. America's market-driven industry, he says, will quickly find itself on an upward spiral constantly fed by new ideas. If Europe does not break its telecommunications monopolies—for both equipment and business services—European industry will suffer badly in a few years when it faces American companies armed with marketing experience and strength from competition.

Time is much shorter than most Europeans realise. Mr Luigi Montella, the deputy general manager of the Italian telecommunications holding company Stet, gives a precise and grim timetable. If there are not big changes in European attitudes within three years, he says, western Europe's telecommunications industry is in trouble.

makes it half-possible in Britain, but it is still far too restrictive.

The biggest category of bad laws are the mobility-inhibitors. Non-portable pensions and tied council flats are British examples. Much of the "job-security" legislation enacted in western Europe in the first two thirds of this century is now having the effect of destroying jobs. Like rent-control laws, such legislation gives a windfall to people who are already in place and hurts newcomers.

Minimum-wage legislation and other restrictions on wage flexibility do damage, but they may not be the worst. Innovative firms have to be able to hire and fire people quickly. Most European industrialists look down the road at industrial tribunals and fat redundancy payments if they hire somebody they might have to let go a year or two later. That is awful for firms just getting started.

Europe's bankruptcy laws are another impediment. Going bust has always been easier in America, and a change in the bankruptcy law in 1978 made it easier still. Bankruptcy in Europe is still, in Mr Riesenhuber's words, thought of as a moral defect; punitive laws enforce that view. That has to change. A lot of failed young businesses is a sign of economic health, because it means that a lot of experiments are being made. The experimenters who crash should be allowed to dust themselves off and try again, not be thought of as "failures".

Out of the gap

This article has made depressing reading for Europeans. But it has also diagnosed ills that are curable. Europe's trouble is not some mysterious ineptitude in information technology or biotechnology. It is instead that these new industries live and breathe innovation—and quickly register a lack of it.

Europe can profitably learn more about this from its cultural cousin in the United States than from still-too-unknown Japan. Silicon Valley is a great American achievement, but it is placed in a more modest perspective by an economy that has lavishly rewarded people who: learned how to mass-market chocolate-chip cookies (Famous Amos and Mrs Fields); dreamt up a way of delivering packages overnight (Federal Express); and worked out how to target political contributors with a direct-mail campaign (Mr Richard Viguerie).

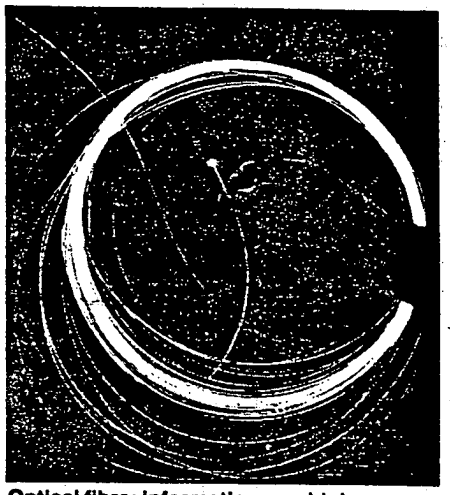
A sluggish approach to information technology can do an advanced economy considerable damage, because the technology affects so much else. But high-tech innovation is only the most visible evidence of a general culture of innovation. And low-tech and no-tech innovation by thousands of small new businesses is what pumps out the new jobs that can more than replace the ones lost by the application of high-tech labour-saving devices to old industries.

Europe's worst response to its predicament would be an attempt to resist change by protecting itself from it. Some dangerous murmurings can already be heard about the need for protection from American competition in telecommunications. This course would be foolish. There used to be some natural protection for a region's industries, thanks to the cost of transporting bulky goods long distances. That hardly exists for the new ones. Mr Ross of Arthur D. Little points out that last year's worldwide production of semiconductors could have been carried in 10 Boeing 747 aircraft. When the competition is in information itself, it will be global and instantaneous. It would be futile to try to build walls against the open market this will create.

There are three general areas of innovation policy that Europe should tend to. The first is the uncommon market. European firms will never have an even chance of competing with their American and Japanese rivals so long as western Europe remains sliced up into a dozen or more semi-separate markets. Governments have wrongly tried to shove responsibility for correcting this on to the shoulders of technocrats, who have only arcane and weak devices such as standardisation and harmonisation at their disposal. It is not a technical problem; it is political. Solving it will require an exercise of political will at least as strenuous as the one which produced the EEC in the first place. Backbone will be needed. Several big European companies will be forced out of the electronics and telecommunications businesses: an open and unified market will not support them all.

The second policy concerns information technology. Europe need not yet despair over being behind America and Japan. The pace of change in the industry means that another train shows up soon after the one you just missed. Nor should Europe be afraid of relying on a lot of small firms (along with big ones) to compete with Americans and Japanese. The successful small ones grow big very fast, and they produce the fresh ideas that keep established rivals on their toes.

But time is short for Europe to get back into the semiconductor game (another five years, perhaps, because of the level of systems integration there will then be on each chip). Europe needs to emulate a Japanese habit in electronics. There is no point in trying to catch up in technologies that already exist. What Europe should do is to absorb as much existing American and Japanese technology as they are willing to license, and use the learning to create its own products for the next round. This is why co-operation agreements between European firms and American partners should be welcome. So should hefty multinational investment in Europe that involves technology transfer. Instead of wringing their hands over IBM's marketing muscle, governments should be enthusiastically stealing whole teams of IBM-trained European employees to set up small entrepreneurial businesses of their own.



Optical fibre: information-age highway

The third area which needs attention is immobility of people. The last thing any country should have in a time of intense innovative activity like this is a harness to prevent old businesses from shrinking or new ones from growing. Job-security, minimum-wage and restrictive-bankruptcy laws all hurt, but so do many other market blockers that at first seem unrelated to labour mobility. The innovations (and new jobs) that People Express introduced into America's airline industry, for example, would never have come without the deregulation of air transport.

It is strange that Europe should be feeling depressed now, when the world is bursting with possibilities that nobody even dreamed about a hundred years ago. The most exciting thing about the new technologies is the freedom they are creating: people now have a much better chance of starting businesses of their own with next-to-no-capital and no connections. It is encouraging that in America's great entrepreneurial boom the number of women-owned businesses has been rising even faster than the number of businesses. The new technologies, in Mr de Benedetti's pretty phrase, are taking the drags off the wheel of human activity and letting it move as fast as human imagination can spin it. Won't Europe jump on board?